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PATENT ABSTRACTS OF JAPAN

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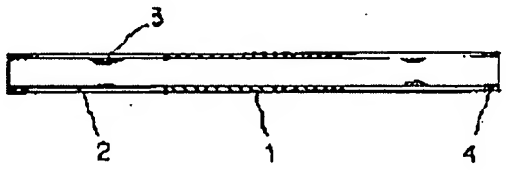
(71)Applicant : TOKAI KONETSU KOGYO CO LTD
(72)Inventor : SAKAMOTO KAZUHISA
NAGASAKI SHIGEO

(54) SILICON CARBIDE HEATING UNIT

(57)Abstract:
PROBLEM TO BE SOLVED: To extend a life of a heating unit by forming a hollow hole in the heating unit, so as to prevent oxygen deficiency of a surface in the hollow hole.
SOLUTION: In this silicon carbide heating unit, a heating part 1 is mainly composed of silicon carbide, and an end part 2 consists of silicon carbide, carbon and metal silicon 3. A hollow hole is formed in both the heating part 1 and the end part 2, to be formed into a structure so that the outside air can be allowed to substantially flow in the hollow hole by natural or forced convection.



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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] The silicon carbide heating element which it is the silicon carbide heating element with which the exoergic section mainly consists of silicon carbide, and an edge consists of silicon carbide, carbon, and metal silicon, and the exoergic section and an edge form a hollow hole, and is characterized by having the structure where the open air can flow into a hollow hole substantially by the free convection or the forced convection.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the silicon carbide heating element used in the field of an industrial heating furnace.
[0002]
[Description of the Prior Art] In an industrial heating furnace, although the electric furnace which makes a silicon carbide heating element a heat source is used, there is a thing of the hollow configuration which consists of the exoergic section and an edge in this silicon carbide heating element. In this silicon carbide heating element, the process of an edge builds independently the approach of sinking into the same silicon carbide Plastic solid as the exoergic section, using metal silicon as an edge at it, and uniting with the exoergic section, or an edge, and the approach of pasting up on the exoergic section is usually taken. When carrying out the process of these, metal silicon and adhesives which are used in case an edge is built adhere to the hollow hole of the silicon carbide heating element of a hollow configuration, and most starts blinding. Usually, since a silicon carbide heating element reacts with the oxygen in atmospheric air while in use, the reaction shown in (1) type occurs, it is covered with SiO2 film made into the heating element inside-and-outside front face and it becomes a protective coat, the reaction of (1) type stops being able to progress easily and the life of a heating element is stabilized comparatively. However, in early stages, as for the silicon carbide heating element with which the hollow hole has started blinding, the reaction of the same (1) type as the above occurs during use. Then, circulation of the open air is intercepted by the blinding of SiO2 protective coat formed in the outside surface, and a hollow hole, it is short of oxygen, and the reaction shown in (2) types occurs, the internal surface of a lifting and an exoergic section hollow hole receives oxidation reaction remarkably, and the interior of heating element hollow keeps the so-called active oxidation phenomenon of silicon carbide in a life very much.

$$SiC + 2O_2 \longrightarrow SiO_2 + CO_2 \quad (1)$$

$$SiC + O_2 \longrightarrow SiO(g) + CO(g) \quad (2)$$

[0003]
[Problem(s) to be Solved by the Invention] The purpose of this invention is to lose the blinding of the hole made in the interior of the hollow hole of the silicon carbide heating element generated on the process, make it structure whose inflow of the open air is attained from a hollow hole by the free convection or the forced convection, and offer the long silicon carbide heating element of a life.
[0004]
[Means for Solving the Problem] That is, in the silicon carbide heating element of the hollow configuration which consists of the exoergic section and an edge, the hollow hole is vacant as for this invention, it can perform the inflow of the open air from a hollow hole, tends to offer the silicon carbide heating element which can be touched by the exoergic section hollow hole internal surface with the open air, tends to prevent the oxygen deficiency of a hollow hole internal surface, and tends to extend the life

of a heating element. Moreover, about the configuration of a heating element, it is not a cylindrical chisel and U typeface, a three phase form, and the typeface of KO are not asked.
[0005]
[Function] Next, a drawing explains this invention. Drawing 1 is the sectional view of one example concerning this invention, and drawing 2 is the sectional view of a cylindrical hollow configuration silicon carbide heating element. Drawing 3 is the sectional view of an example having shown the condition of the heating element of this invention in use. Drawing 4 is the sectional view of an example which inserted the heating element of this invention in the electric furnace. As shown in drawing 1 , as for the silicon carbide heating element, an edge 2 and the polar zone 4 are formed in the both sides of the exoergic section 1. The blinding of this edge hollow hole is canceled, the active oxidation phenomenon by the oxygen deficiency of an internal surface can be prevented, and the life of a heating element can be made to extend by enabling the inflow of the open air at an exoergic section hollow hole internal surface.
[0006]
[Example] Next, an example explains this heating element. Furnace wall thickness inserted the silicon carbide heating element concerning this invention shown in an electric furnace with 250mm, the dimension in a furnace of 400mm, a height [of 200mm], and a depth of 600mm at drawing 1 , as shown in drawing 4 . The hollow hole is vacant as for the above-mentioned silicon carbide heating element in the outer diameter phi 20, the bore phi 10, the overall length of 1000mm, and the hollow configuration of the shape of a with a resistance [of 1.8 ohms] rod, and the open air can flow into an exoergic section hollow hole internal surface. A vertical horizontal is made to insert a total of eight of these four heating elements each in the above-mentioned electric furnace, and the polar zone of an edge was made to be exposed out of the furnace wall 50mm from the furnace wall through tube. The load of the 12kW of the power was carried out to this electric furnace, whenever [furnace temperature] was held at 1400 degrees C, and in order to judge the time amount from which resistance of a heating element will be 3 times the initial value to be a life, the time amount was measured. The conventional silicon carbide heating element shown in drawing 2 was measured on the same electric furnace and the same conditions for the comparison. The open air inflow from a lifting and a hollow hole is completely intercepted in blinding with the metal silicon with which a hollow hole uses the here conventional silicon carbide heating element into an edge production process in outer-diameter phi20mm, bore phi10mm, the overall length of 1000mm, and the hollow configuration of the shape of a with a resistance [of 1.8 ohms] rod. A measurement result is shown in Table 1.
[0007]
[Table 1]

	本発明	従来の発熱体
発熱体の抵抗値が初期抵抗値の3倍となるまでの経過時間	２５１８時間	１２５３時間

As shown in Table 1, this invention became possible [extending time amount until the resistance of a silicon carbide heating element increases by 3 times the initial resistance, and the so-called life twice / about].
[0008]
[Effect of the Invention] As mentioned above, this invention can become possible [extending the life of a silicon carbide heating element twice / about / over the past], a quality heating element can be offered from now on, and the effectiveness to the industrial world of this invention can be called size.

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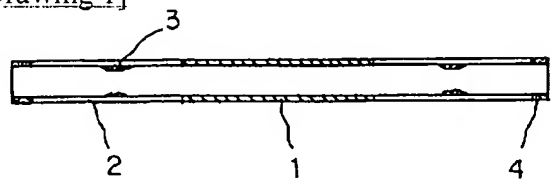
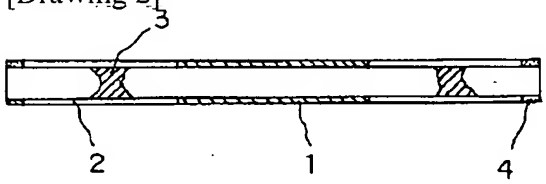
DRAWINGS

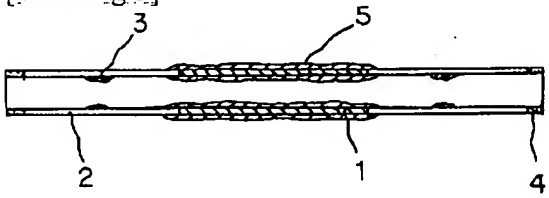
[Drawing 1]



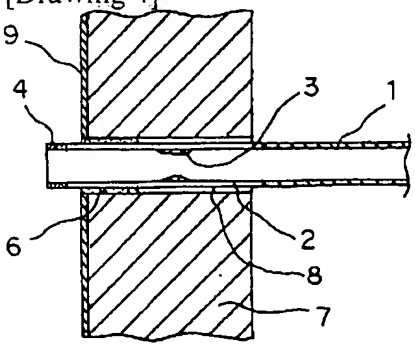
[Drawing 2]



[Drawing 3]



[Drawing 4]



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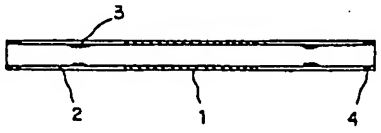
審査請求　未請求　請求項の数１　書面　(全　3　頁)

(21)出願番号　特願平7－208956
(22)出願日　平成７年(1995)７月14日

(71)出願人　000219750
東海高熱工業株式会社
東京都新宿区西新宿６丁目14番１号
(72)発明者　坂本　和久
愛知県知立市弘２丁目38番地
(72)発明者　長崎　茂夫
愛知県中島郡平和町大字西光坊200

(54)【発明の名称】　炭化珪素発熱体

(57)【要約】
【目的】　中空形状の炭化珪素発熱の発熱部の中空穴内表面の酸欠によるアクティブ酸化を防ぐことにより、寿命の長い炭化珪素発熱体を提供する。
【構成】　発熱部と端部とからなる中空形状の炭化珪素発熱体において、中空穴から外気が流入でき、発熱部の中空穴内表面が外気と触れることが可能な構造とする。



【特許請求の範囲】

【請求項１】　発熱部が主として炭化珪素からなり、端部が炭化珪素、炭素および金属珪素からなる炭化珪素発熱体であって、発熱部、端部ともに中空穴を形成し、自然対流又は強制対流により、中空穴に実質的に外気が流入できるような構造を有することを特徴とする炭化珪素発熱体。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、工業加熱炉の分野において使用する炭化珪素発熱体に関する。

【０００２】

【従来の技術】工業加熱炉において、炭化珪素発熱体を熱源とする電気炉が使用されているが、この炭化珪素発熱体には、発熱部と端部からなる中空形状のものがある。この炭化珪素発熱体において、通常端部の製法は発熱部と同じ炭化珪素成形体に金属珪素を含浸して、端部とし、発熱部と一体化する方法、あるいは、端部を別に造り、発熱部に接着する方法が採られている。これらを製法する上で、中空形状の炭化珪素発熱体の中空穴には、端部を造る際に使用する金属珪素や接着剤が付着し、目詰まりを起こしてしまうのがほとんどである。通常、炭化珪素発熱体は使用中に、大気中の酸素と反応し、（１）式に示される反応が起き、発熱体内外表面にできたSiO_2膜により、被覆され、保護膜となるため、（１）式の反応は進みにくくなり、発熱体の寿命は比較的安定する。しかし、中空穴が目詰まりを起こしている炭化珪素発熱体は、使用中初期には上記と同じ（１）式の反応が起きる。その後、発熱体中空内部は、外表面に形成されたSiO_2保護膜と中空穴の目詰まりにより、外気の流通が遮断され、酸欠状態となり、（２）式に示される反応が起き、いわゆる炭化珪素のアクティブ酸化現象を起こし、発熱部中空穴の内表面が著しく酸化反応を受け寿命に至ってしまう。

$$SiC+2O_2 \longrightarrow SiO_2+CO_2 \quad (1)$$

$$SiC+O_2 \longrightarrow SiO(g)+CO(g) \quad (2)$$

【０００３】

【発明が解決しようとする課題】本発明の目的は、製法上で発生した炭化珪素発熱体の中空穴内部にできた穴の目詰まりをなくし、中空穴から自然対流または強制対流により、外気の流入が可能となるような構造にして、寿命の長い炭化珪素発熱体を提供することにある。

【０００４】

【課題を解決するための手段】即ち、本発明は、発熱部と端部からなる中空形状の炭化珪素発熱体において、中空穴が空いており、中空穴から外気の流入ができ、発熱部中空穴内表面が外気と触れることが可能である炭化珪素発熱体を提供し、中空穴内表面の酸欠を防ぎ、発熱体の寿命を延長しようとするものである。また、発熱体の形状については、棒状のみでなくＵ字形、三相形、コの字形を問わない。

【０００５】

【作用】次に、本発明を図面により説明する。図１は、本発明に係る一実施例の断面図で、また図２は、棒状中空形状炭化珪素発熱体の断面図である。図３は、本発明の発熱体の使用中の状態を示した一例の断面図である。図４は、本発明の発熱体を電気炉に接着した一例の断面図である。図１に示すように、炭化珪素発熱体は発熱部１の両側に端部２及び電極部４が形成されている。該端部中空穴の目詰まりを解消し、発熱部中空穴内表面に外気の流入を可能にすることで、内表面の酸欠によるアクティブ酸化現象を防ぎ、発熱体の寿命を延長させることができる。

【０００６】

【実施例】次に本発熱体を実施例により説明する。炉壁厚が２５０mm、炉内寸法４００mm、高さ２００mm，奥行６００mmの電気炉に図１に示す本発明に係る炭化珪素発熱体を図４に示すように接着した。上記の炭化珪素発熱体は、外径φ２０、内径φ１０、全長１０００mm、抵抗値１．８Ωの棒状の中空形状で中空穴が空いており、発熱部中空穴内表面に外気が流入可能なものである。該発熱体を上記の電気炉に上下水平に各４本、合計８本接着させて、炉壁貫通孔から端部の電極部が、炉壁外に５０mm露出されるようにした。該電気炉に電力１２KWを負荷し、炉内温度を１４００℃に保持し、発熱体の抵抗が初期値の３倍となる時間を寿命と判断するため、その時間を測定した。比較のため、図２に示す従来の炭化珪素発熱体を同一電気炉、同一条件で測定した。ここで従来の炭化珪素発熱体は、外径φ２０mm、内径φ１０mm、全長１０００mm、抵抗値１．８Ωの棒状の中空形状で、中空穴が端部製造工程中に使用する金属珪素によって、完全に目詰まりを起こし、中空穴からの外気流入が遮断されているものである。測定結果を表１に示す。

【０００７】

【表１】

	本発明	従来の発熱体
発熱体の抵抗値が初期抵抗値の3倍となるまでの経過時間	2518時間	1253時間

表1のように、本発明は、炭化珪素発熱体の抵抗値が初期抵抗値の3倍に増加するまでの時間、いわゆる寿命を約2倍に延長することが可能となった。

【0008】

【発明の効果】上述したように、本発明は炭化珪素発熱体の寿命を従来の約2倍に延長することが可能となり、今後、品質の良い発熱体を提供することができ、本発明の産業界への効果は大といえる。

【図面の簡単な説明】

【図1】本発明に係る棒状の炭化珪素発熱体の一実施例の断面図である。

【図2】従来の棒状の炭化珪素発熱体の断面図である。

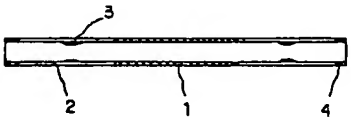
【図3】本発明の棒状の炭化珪素発熱体の使用中の状態を示した一実施例の断面図である。

【図4】本発明の発熱体を電気炉に装着した一実施例の断面図である。

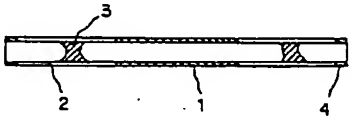
【符号の説明】

1．発熱体
2．端部
3．金属珪素
4．電極部
5．SiO_2 保護膜
6．断熱ファイバー
7．炉盤
8．炉盤貫通孔
9．外盤

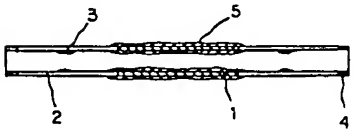
【図1】



【図2】



【図3】



【図4】